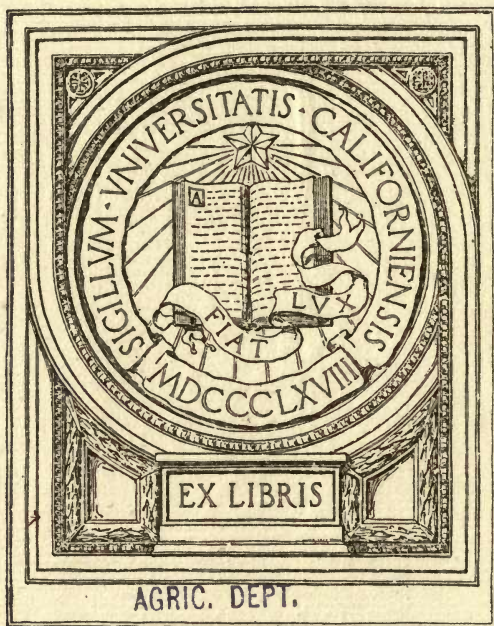


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THE
HESSIAN FLY

CECIDOMYIA DESTRUCTOR

IN
GREAT BRITAIN:

BEING
OBSERVATIONS AND ILLUSTRATIONS FROM LIFE.

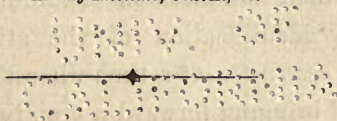
With Means of Prevention and Remedy

FROM THE REPORTS OF THE DEPARTMENT OF AGRICULTURE,
U.S.A.

BY

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LONDON:

SIMPKIN, MARSHALL & CO., STATIONERS' HALL COURT

1886.

PRICE SIXPENCE.

4s. per dozen; 25s. per hundred.

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THE following pages are an endeavour to give a short account of the new crop-pest which has appeared amongst us, so far as we have as yet traced its history here. For the methods by which its ravages may be counteracted we are under obligations to the observers, and to the agricultural entomologists of other countries, where these have long been studied, and especially to those of the United States of America; and in quoting from their works, and to some slight extent making use of their illustrations, I have endeavoured fully to acknowledge the source, and also to separate these observations clearly from the British experiences of the past autumn.

I beg also to express my sincere thanks to the eminent entomologists, whose names I have given in the following pages, for their kindness in examining into and confirming my identification of the attack as that of *Cecidomyia destructor* at a time when the task of identification and bringing forward a crop injury never before known in the country was a most anxious responsibility which they assisted greatly to lighten.

E. A. O.

THE HESSIAN FLY IN BRITAIN

IN 1886.

As far as at present appears there has been no recorded presence of the Hessian Fly in Britain until the latter end of July of the present year.

Those who desire to trace its history from its first outburst as a destructive scourge in North America during the years 1786 to 1789, with full reports of its history, habits, gradual spread, destructive powers, and ravages up to complete attacks of crops onwards, the date of its first proved appearance in Europe, and the testimony borne (up to July of the present year) of the absence of this pest from our own country, will find information on these subjects in the works whose titles are quoted in the appended table.

Relatively to the watch instituted on its very first appearance in America lest this pest should be transmitted to our own land, we find that in 1788 the wheat crop was so much injured in various North American localities, from which corn was then exported in large quantities to Great Britain, that the exportation of grain from America was prohibited until the English Government was assured that the fly with eggs could not be introduced in the grain*; and next, that consequently on the annually recurring tidings of the more and more widely extending devastations of the Hessian Fly in America, the investigations on this side the Atlantic were set on foot by Sir Joseph Banks, the result of which was, as reported by him, "that no such insect

* Bulletin No. 4 of U. S. Entomological Commission.

could be found by him to exist in Germany or any other part of Europe.”*

An alarm took place as to the arrival of the pest about the beginning of the present century, which was proved to be unfounded by evidence that it was another kind of fly.† The well-known passages in Kirby and Spence's 'Entomology' as to the destructive character of this pest if it gained footing give a long range onwards of *non-observation* from about 1815 to the date of the edition of 1855; and in 1845 John Curtis notices the attack as one which, as it had *then* been detected in Europe, it was well to mention. And, in the summary of information given in the 'Report on Hessian Fly,' brought out by the United States Entomological Commission, 1880-82, I find these statements: "We know that the *Cecidomyia destructor* does not inhabit England or Scandinavia."‡

Throughout this course of years we do not find any authentic notice of the Hessian Fly occurring on our side the Atlantic until possibly 1833 in Hungary, but the first sure statement of the existence of the Hessian Fly in Europe is considered to be that of "its discovery, by Mr. J. Dana in 1834, at Mahon, Toulon, and Naples" ("Hessian Fly not imported from Europe," 'Canadian Entomologist,' 1880).

It is now known to exist in the South of France, Austria, Hungary, and during the last seven years its presence has been reported in Southern Russia, and its original habitat is considered most probably to have been Southern Europe and Western Asia, *i.e.*, about the shores of the Mediterranean Sea. (Report of U.S.A. Comm., previously cited).

The past summer has shown its presence amongst ourselves. On July 27th the first specimens of the peculiar

* Dr. B. Wagner on Hessian Fly. Report of U. S. Entomological Commission, 1880-82; Appendix I., p. 28.

† See Linn. Trans., ii., 76-80.

‡ The name of Hessian Fly was originally given in consequence of the fly being noticed about the same time with the arrival of the Hessian troops in America. Those who wish to see the evidence by which this

flax-seed-like pupa were forwarded to me by Mr. G. E. Palmer from his barley fields near Hertford, and shortly after the attack was reported as found on other neighbouring farms. On August 10th some small amount was found at Stubbers, near Romford, Essex, in wheat; on August 28th the same attack, with pupæ now advanced to the striated condition (that is, with lines running lengthwise along them), was found at Ware; and on September 1st and 2nd respectively similar attack was reported (with specimens accompanying) from barley near Inverness, and also from barley near Crieff, Perthshire. In all cases the nature of the attack was identified by sample specimens forwarded to me. Reports were also sent me of similarly injured straw being observed in various parts of Scotland, and that "the insect had been observed in various counties widely apart."

On September 22nd Mr. G. E. Palmer reported that the pupæ of the Hessian Fly had been found at three farms near Hertford, two farms near Hitchin, one near Ware, and one near Luton, Bedfordshire. These localities include Mr. Palmer's farm and that at Ware previously mentioned. The observations were taken by Mr. Palmer and Mr. H. Dorrington, residents near Hertford, perfectly qualified to identify the attack.

Amount of injury caused by Hessian Fly attack.

It is unnecessary here to enter on the losses liable to be caused by this attack, of which details will be found in the works referred to in table appended. They may

transmission is thoroughly disproved will find the subject entered on at length in a paper by Dr. Hagen, entitled, "The Hessian Fly not imported from Europe," 'Canadian Entomologist,' October, 1880. The dates, with names of ports of embarkation and those of arrival in America, are there given both of the Hessian and German troops; and (to give just one note of the various movements specified) it will appear plain that where troops left Hesse in February, Spithead in May, and arrived in Sandy Hook in July, or up to August 12th, that the "flax-seeds" could not by possibility be thus conveyed. If pupæ had been in the straw (if straw was conveyed) they would have developed long before the middle of summer, if they were in a state to develop at all. Full details will be found in the paper referred to.

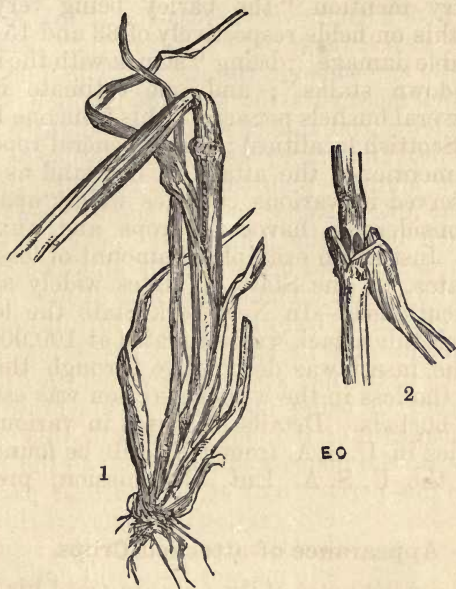
be shortly stated as any amount from slight attack up to devastation of whole large districts. Some of the communications regarding amount of attack this year in this country mention "the barley being very much injured" (this on fields respectively of 33 and 15 acres); "considerable damage"; being "struck with the number of broken-down stalks"; and one estimate is of a "loss of several bushels per acre" (this from one English and three Scottish localities); and a general report sent to myself mentioned the attack in Scotland as having "been observed in various counties widely apart, and causing considerable havoc to crops and anxiety to farmers." Just as an example of amount of loss in the United States, in one State, at dates widely apart, it may be mentioned:—In New York State the loss last year through this attack was estimated at 100,000 dols.: in 1846 the insect was destructive through the whole State, and the loss in the western section was estimated at 500,000 bushels. Details of losses in various years and localities in U. S. A. from 1776 will be found in the Report of the U. S. A. Ent. Commission, previously quoted.

Appearance of attacked Crops.

In Mr. Palmer's notes of the appearance of his infested fields, he mentioned that at first he thought that the barley was "simply root-fallen," but on closely examining the stems he found that most of them had given way just above the second joint from the root, and then found that the maggot, of which the chrysalis was sent, was the cause of the attack; and in the report of the attack from near Perth there is similar mention of the broken-down stalks and small brown pupæ found at the injured part.

On examination in the fields near Hertford, on the 30th of July, I found the stems doubled sharply down a little above the joint, as shown in fig. 1, No. 1, and between this double and the joint below there lay, closely pressed to the stem and covered by the sheathing-leaf, the

flax-seed-like chrysalis-cases, figured on the right hand of the bent stem. The injury is caused by the fly-maggots lying at the same spot sucking the juices from



No. 1.—Attacked Barley-stem ; 1, bent down ; 2, showing “ flax-seeds.”

the stem, which is thus weakened, and presently, although both the stem and the ear above are more or less stunted, yet the weakened piece of stem cannot bear their weight, and it bends sharply down at the injured part. Sometimes a gall or some amount of swelling of the stem occurs just above where the maggot fed, but in the specimens I examined this was rarely noticeable. I am told by Mr. John Marten, of Albion, Illinois, U. S. A., an economic entomologist who has especially made a study of this attack, that the specimens I showed him corresponded in absence of gall with the condition of those in Illinois.

“Flax-seeds,” Chrysalis-cases, or Puparia.

These were from one up to sometimes three or four in number, usually only one or two; they were invariably set upright (not lengthwise across the stem), and sometimes, but not always, were fixed at the lower end by being a little embedded in the straw. The “flax-seeds” were for the most part the sixth of an inch long, of a spindle or long oval shape, somewhat slightly flattened on one side, and more so on the other; the two extremities bluntly pointed, one conical, the other, which is the anterior end, usually slightly bent forward with a pinch across the “flax-seed” near the end, as if the flattened side had been bent in almost against the other side by a nail. The colour was at first of various shades of chestnut, from quite light to full brown, and both in colour and in shape the cases had a strong resemblance to the flax-seeds from which they take their name, except in being narrower. This brown case is the hardened skin of the maggot, and in this *puparium*, or pupa-case, the maggot changes first to the *pupa* and thence to the perfect fly; at the earliest part of the



Fig

No. 2.—“Flax-seeds” or Puparia, in different stages of development, nat. size and mag.

observation the transverse lines showing the divisions of the segments of the maggot were still noticeable, but gradually, as the skin hardened, it contracted lengthwise, and the transverse lines wholly or almost entirely disappeared, and instead of these the flax-seed was marked with parallel lines. The first specimen in which I noticed these running along it from one end to the other was sent me from Ware on the 28th of August.

The figure is taken from two of my own specimens in different stages of development at the beginning of October.

Contents of the "Flax-seed," Chrysalis-case, or Puparium.

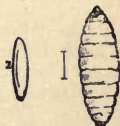
As the attack had passed into the flax-seed state before it was reported, I had no opportunity of observing the maggot whilst it was still active and in feeding condition; therefore, in order to keep the British observations clearly distinct from those of other countries, the description and figure of the maggot taken from Dr. Packard's paper on the Hessian Fly is appended in a note.* I had, however, the opportunity, by careful dissection of a newly-formed "flax-seed," of making out some of the points of the structure of the larva. On opening the brown case I found the legless maggot within still unchanged as to development; it was bluntly oval, with the head retracted, and it was of a white milky colour, excepting at the divisions of the segments and also along the central line from one extremity to the other, which were all of a greyer tint. This appearance is stated by Dr. Wagner to be the beginning of the development of the adipose body, which "is distinguishable as snow-white masses from the remainder of the more transparent body."† Beneath the maggot, close to the head-end, was the chitinous appendage, which is known in America as the "breast-bone" of *Cecidomyideous* larvæ, with us as the "anchor-process."

* "*The egg* is very minute, about the fiftieth of an inch long, cylindrical, pointed at each end, the shell shining and transparent, the egg being of a pale red colour when the embryo is nearly developed."

"*The larva*.—After remaining about four days in the egg-state the larva or maggot of the Hessian Fly hatches, and is of the form represented. The body is soft, smooth, shining, oval, cylindrical, beneath a little flattened, and consists of twelve segments besides the head, the latter soft, fleshy, and but little separated from the body, with very rudimentary mouth-parts."—Hessian Fly Report of Department of Agriculture, 1880 - 82, p. 208, previously cited.

The above figures of egg and larva are copied from the same. The larva, when fairly advanced in growth, is stated by Dr. Wagner to be white or yellowish white, transparent at the sides.

† Dr. Wagner on the Hessian Fly, Appendix I. Third Report of United States Entomological Commission, 1880.



R+P

No. 3.—Egg and maggot of Hessian Fly, nat. size and mag.

As I am not aware that this anchor-process of the larva of the *Cecidomyia destructor* has as yet been precisely figured, I give a magnified sketch from my own British specimens. The anchor-process is a short stem fixed at one end to the larva, and free at the other; the



No. 4.—1, anchor-process of larva of *C. destructor*; 2, of *C. tritici* (magnified).

free end, which points forward, is considerably enlarged, and is of various form. In the "red maggot" of our own British Wheat Midge it is notched, as at fig. 2, No. 4, but in the anchor-process of the Hessian Fly the shape is more elaborate. The stem is slightly enlarged at the middle, and the extremity furnished with two conical prolongations, forming together a strong fork. When seen sideways the process looks more slender, and has a curved figure making a gentle arch from the insertion to the forked tip.

The use of this appendage does not appear as yet to be fully known, but from my own observations I conjecture that it is used as a digger or scraper, and it may be that the reason why strong-stemmed wheat, or stems containing more silica, are not so much injured by attack as other kinds, is, that the fork is not strong enough in these instances to assist the excessively delicate mouth-parts to acquire their food from the stem.



No. 5.—Skin of larva, magnified.

The formation of the skin of the maggot is very peculiar, and, as seen under a $\frac{1}{4}$ -inch power, resembles nothing so much as a nutmeg-grater. It is covered with most minute tubercles, each about the height of its own width, and each with a depression or orifice in centre. The two figs. at No. 5 give a view sideways and from above of these tubercles, from the dried skin of a larva taken from the puparium with the anchor-process attached.

About the beginning of October, on again examining

the contents of a "flax-seed," I found the larva or maggot within considerably altered. It did not as yet, as far as I saw, show any development of limbs, but it was now changed to a reddish yellow colour, of a brighter red along the back. As these changes of tint are stated by Dr. Wagner to follow almost immediately on the rudiments of the coming wings being observable, it is probable that examination with a better light, or with a stronger microscope-power, would have shown their appearance.



No. 6.—*CECIDOMYIA DESTRUCTOR*, Say. Hessian Fly, natural size and magnified.*

The Imago or perfect Fly.

On the 8th of September the first fly developed from my "flax-seeds" or puparia. This to the naked eye was a stout-made little brown gnat, with darker head and body, legs of rather lighter brown, brown horns, and a pair of smoky-grey wings with longitudinal veins. It was exactly one-eighth of an inch in length.

In order to note the successive changes in colour occurring up to maturity and immediately after death, I observed the specimen at intervals for about three days, and endeavour to give the result as plainly as I can. The fly was first noticed about four in the afternoon amongst my specimens of infested straw, and I

* The position of the imago is after the fig. f. by Mr. Burgess in plate iv. of paper on Hessian Fly in Third Report of U. S. A. Ent. Comm. already quoted; the details, &c., from my own British specimen.

secured it by passing a long fine rod of twisted paper just moistened at the tip with chloroform beneath it; this stupefied but did not quite kill it, so that I could observe it with very slight disturbance from movements of the insect.

About three hours after being first noticed the abdomen, as seen with a 1-inch power, was of various tints of a yellow-brown colour.* The following morning, on investigation of details, the thorax was black above, yellow or pale yellowish brown beneath the root of the wing, and with another patch of the same colour in front,—that is to say, a patch about half-way down on each side of the prothorax. The six segments of the abdomen nearest the thorax of a raspberry colour, paler below, with a broad black transverse band extending over the back and half-way down the side of each segment, which was also marked with a well-defined black velvety patch on each side. The terminal segments of the abdomen and the extended ovipositor were of nearly the same shade of yellow, or pale yellowish brown as the patches on the side of the fore body, and the ovipositor was *not* furnished with lamellulæ at the extremity. The 7th and part of the 8th segments were marked above with a small V-shaped figure with a fine line on each side, parallel to the sides of the V, the lowest end of the V pointing backwards. This figure was only noticeable when the abdomen was seen from above, and was not of deep tint.

The halteres or poisers were of a bluntly-pointed club-shape at the extremity, and yellow with a sprinkling of hairs, which in some lights gave a blackish tint to the upper part and also to the base of the club, and at this stage there was a marking of raspberry-red just about the middle of the poisers. The body and abdomen were in parts very hairy, and the black velvety patches on the sides of the abdomen appeared to be composed of

* For fuller descriptions than I can give from my own observations of the early changes of colour the reader is referred to Dr. Wagner's paper previously referred to.

stout, black, bristle-like hairs. The two wings smoky grey, fringed at the edges with long fine hairs, and sprinkled over the surface with hairs, and also with ribbed scales, resembling one of the forms found on butterflies' wings. The wing-veins all ran lengthwise, the first almost close to the front margin of the wing, running parallel to it, and uniting with it about half-way down; the second running straight along the wing at rather less than one-third of the whole width of the wing from the front, until near its termination at the tip of the wing it curved slightly backwards; the third vein (placed about the width above mentioned from the hinder margin) runs almost straight, ending at the hinder margin about one-quarter of the length of the wing from its tip; this third vein throws out a side-branch, which curves backwards to the hinder margin of the wing exactly opposite the termination of the first vein. Legs very long and fine, yellowish brown, hairy; uppermost joint of tarsi very short. Eyes black; antennæ beaded, long, and hairy. The two basal joints shorter and wider than the succeeding beads. The remainder of these up to the apical joint (with the exception of those immediately succeeding the basal joints)* were rather longer than wide, apparently cylindrical in form, and slightly contracted at the middle; the terminal joint was bluntly pointed and about as long again as the preceding bead. These joints were at first distinctly stalked, so that, excepting towards the end of the antenna, they could be seen to be distinctly separated. From the minuteness of the division, and also as with maturity and death, the beads drew so nearly together as almost to appear to touch, I had great difficulty in counting them, but after repeated



No. 7.—Wing
of Hessian
Fly, mag.

* I unfortunately omitted to make a note of the precise form of these at the time; from memory I should say they were like the corresponding joints of the male antennæ, as figured by Dr. Packard, but not having figured and noted them at the time the observation may not be correct.

examination they appeared to me to be nineteen in number, that is 2 plus 17. The colour altered with change of condition of the specimen, but might throughout be called brown.

The above account refers to the condition of the specimen whilst still not quite dead, about eighteen hours after the first observation. Twenty-four hours later the raspberry tints were changing to shades of brown or yellowish brown, and the black velvety patches at the sides of the abdomen were scarcely distinguishable from the transverse bands. The changes in colour continued, till on the third day from the first observation the raspberry tints had changed to dark brown above, lighter or yellowish brown below, the terminal segments and the ovipositor still retaining the original tint of yellowish brown.

From minute examination of structure and comparison with the descriptions and figures in the works cited, the imago appeared to me to be without doubt the *Cecidomyia destructor* of Say, commonly known as the "Hessian Fly."

In an attack of this importance, regarding which it is yet to be seen whether it will settle in the land as a national scourge, or be a temporary infliction from causes not yet made out, I in no way desired to rest solely on my own opinion. I therefore submitted infested straw to Professor Westwood, Life-President of the Royal Entomological Society, who is personally acquainted with the insect in the "flax-seed" as well as in the perfect state, and also forwarded others to Prof. W. Saunders, President of the Entomological Society of Ontario, Canada, a well-known and most sound authority in the matter, and received from both the above referees the confirmation that the specimens sent were without doubt the pupæ of the true Hessian Fly. On the appearance of the imago I submitted it for special examination to Mr. R. H. Meade, of Manningham, Bradford, whose researches on the Diptera are too well known to require any comment, and had from him the

benefit of definite opinion that it was *Cecidomyia destructor*, Say. Further, I have had the opportunity of submitting the whole series of specimens to Mr. John Marten, of Albion, Illinois, U.S.A., one of the economic entomologists of Illinois, known by his papers on injurious insects, published in Reports of the Department of Agriculture, U.S.A., and whose opinion is of much value, as having made a special study of the Hessian Fly.

Abstract of Life-History.

The following extract from a German source* gives the main points of the life-history of the fly in Europe in short and plain form :—

“*Cecidomyia destructor*, Say.—The larvæ live in the haulm of wheat, rye, and barley. The female flies usually lay their eggs on the young leaves twice in the year,—in May and September,—out of which eggs the maggots hatch in fourteen days. These work themselves in between the leaf-sheath and the stem, and fix themselves near the three lowest joints, often near the root, and suck the juices of the stem, so that later on the ear, which only produces small or few grains, falls down at a sharp angle. Six or eight maggots may be found together, which turn to pupæ in spring or about the end of July, from which the flies develop in ten days.”—Stett. Ent. Zeit., xxi., p. 320.

Where does Hessian Fly come from ?

The question now arises, Where does the attack of Hessian Fly come from ? It does not appear to have risen up gradually in the country, as we find it widely spread,—that is, in various parts of Scotland, as well as in one district of England,—without any observation of its previous presence having been reported from any quarter, although the attack is of a kind which is very observable, and attention is given to insect injuries to the crops more or less in every part of the island. It

* See Die Pflanzen feinde, von J. H. Kaltenbach. Stuttgart.

may come in the "flax-seed" state in straw imported from any of the countries troubled by this pest; it may be received from Canada, or from the United States, or from the South of Europe, Austria, Hungary, or Russia.

In respect to its importation in straw, it may come in straw-cargoes, or in straw used as packing material. Where this straw is sent forward to farms as it is, or as slightly-used litter, or as "long" manure, quite a sufficiently large proportion of the flies in the flax-seeds are likely to develop to cause mischief such as we have seen in the past season. On the first farm on which the attack was observed near Hertford, I found on enquiry that London manure had been used of mixed kind, but mainly cow and horse manure in "very long" condition.

Another way in which it is at least possible that the "flax-seeds" may be transmitted is in wheat or barley from infested countries. This method of transmission is stated not to be at all likely, because the sheathing-leaf enfolds the wheat or barley stem so tightly just above the joint where the pupæ lie that it is considered they would not fall out in the process of threshing. But on investigation of the attacked straw, both in the field and after being stored away, I found it very liable to break at the bend, and thus expose the contained "flax-seeds"; and on October 22nd I received information from Mr. Palmer, of Revell's Hall, that after threshing some of his infested barley he examined the small seeds and dust sifted out of the threshed corn which fell beneath the machine, and in this he found "flax-seeds" to the amount of fifteen in a handful of siftings. Specimens of these were forwarded to me.

No pupæ were found in chaff or grain. This matter will be further investigated by observations from other farms, and all information is solicited on the point, as it is of enormous importance.

In cleaning seeds of the fox-tail grass from those infested by *Cecidomyia* of another species, it is found the infested seed, being lightest, falls at a separate spot;

and, if we find that the Hessian Fly puparia fall just below the machine customarily, there will be neither difficulty or loss in collecting the rubbish and dirt and destroying it.

From the above observation it appears that puparia or "flax-seeds" may be transmitted in corn rubbish. In samples of screenings and "sweepings" from imported corn I have found, besides a large amount of live and dead beetles, also weed-seeds, smut, and other matters undesirable to spread abroad (as may easily be done where these are used for poultry-food, and thus thrown out in farmyards), and as, with these, broken bits of stem are to be found, it appears at least possible that "flax-seed" may also be conveyed. In Dr. Packard's paper on the subject (previously quoted) he alludes to the possibility of the pest being transmitted in wheat.

Methods of Prevention.

At present nearly all we know on this head is learnt from agricultural publications of other countries, and especially from the Reports of the Agricultural Department of the United States, but in our own country we have one regular and constant safeguard against autumn attack in the fact that wheat in this country is not sown usually until well after the time when plants may be considered safe from eggs being laid upon them by the autumn brood of the Hessian Fly.

This point of prevention is stated as follows in the Third Report of the United States Entomological Commission: "*Late sowing of most of the wheat seed. All writers, both entomological and agricultural, concur in recommending this easily applied remedy, that at least a part of the wheat should not be sown until after the 20th September in the Northern States.*"*

In this country this remedy is applied for the most part in regular process of farming arrangements;

* See Third Report of United States Entomological Commission, Department of Agriculture, p. 221, 1880-82.

commonly our wheat is not sown until some time after date named, and thus the young plant is not up until the flies which would have laid eggs on it are dead.

The Hessian Fly has commonly two broods in the course of the year. The flies which come out in August or September from the "flax-seed" chrysalis-cases, sheltered above the second joint of the straw from the ground (such as we have this year been troubled with in England and Scotland), lay their eggs, we are informed by various observers, Prof. Riley, the State Entomologist, amongst the number, in the grooves on the surface of the leaves, or between the stalk and sheath where loose, and, as soon as the footless larva or maggot hatches, it makes its way down the leaf to the base of the sheath, which in the young winter wheat is at the crown of the root. Here it is stated to fasten itself lengthwise to the tender stalk, and to move no more, but remain fixed at one spot sucking the juices until it becomes embedded at one extremity in the outer part of the stalk, and in five or six weeks, according to the season, to turn to the flax-seed chrysalis. In the case of attack to the young wheat, the maggots drawing away the juices just near the ground-level, cause it to turn yellow and die.

The flies from these "flax-seeds" come out in spring, or about the beginning of May, and, as where the corn is running up to stem the tender ground leaves are no longer to be found, which are used for autumn egg-laying, the flies have no choice, but they lay them instead, as we know, so that the maggot when hatched shelters itself between the stem and sheath just above the first or second joint from the ground, and there it turns to the flax-seed chrysalis, from which the autumn brood presently come out.

To return to autumn means of prevention, as previously said, if there is no accommodation ready for the autumn brood, a great deal of it necessarily perishes without egg-laying, but further (in case quite early-sown wheat is found to be infested), by *ploughing this in* the maggots and eggs will be killed; and, in the words of Dr. Packard,

this brood may be circumvented or destroyed so that a spring brood cannot appear from it.

A less expensive method of attracting the flies is the use of what is called "bait," that is, sowing some narrow strips of wheat to attract the flies, *and ploughing this in with the eggs and maggots*; but for ourselves the plan arranged by Mr. G. Palmer on his farm of Revell's Hall, near Hertford, appears best of all as costing little or nothing, and meeting all purposes.

Mr. Palmer showed me that on his worst infested barley field, which was bare at the root, he had allowed all the self-sown barley to sprout; thus it was ready for attack of all the flies which were hatching, or might be hatching, out of the "flax-seeds."* When the time was passed the plant was to be fed off by sheep, which would eat the leaves with eggs on them, and any maggots which had effected a lodgment in the centre of a plant too far down to be bitten out would be effectually killed by the subsequent ploughing coming in regular course of operations.

The above refers to where stubbles are left; where they have been cut high so as to leave the infested part standing on the field it is probably the best plan at once to skim and collect the stubble and burn it, but from the practical difficulties in the way of carrying out this high cutting, and the amount of loss entailed, it does not seem likely to be carried out.

Deep ploughing directly after cutting of stubbles which have been infested would turn any "flax-seeds" which had been shaken out well under, so that the flies from them, even if they did hatch out, could not make their way to the top. Where there is clover or seeds it does not seem possible to do anything relatively to attack that may very likely recur on the self-sown

* Nov. 1st, 1886. During the last few days specimens have been sent from these plants, and shoots from old plants infested with Hessian Fly puparia in various stages, from white condition just passing from larval state up to regular "flax-seed." This shows that the *puparia* found in the corn-stems in August, or a portion of them, do hatch out their flies in this country, and confirms the need of every precaution.—E. A. O.

corn, excepting what may be done to kill the young maggots or "flax-seeds" by dressings; for this purpose the use of lime, salt, or soot have been recommended.

In regard to infested straw taken off the field, I am informed by Mr. John Marten (quoted previously) that it is found to answer well to stack this carefully after threshing, well built up square and firm, like a haystack, instead of throwing it anyhow; thus a very great proportion of the flies which come out of the "flax-seeds" are destroyed, simply because they are not able to get to the outside of the stack.

It is difficult to see how, except on a broad scale, by arrangement like the above we can manage to meet the difficulty of attack spreading from infested straw. In any common way in which it is used it is open to letting the fly escape from it, and it is impossible without very severe loss to destroy it. The method of saving the straw which places the greater amount of it in a condition in which it cannot spread attack, whilst being stored for gradual use, seems worth consideration.

With regard to chaff and rubbish from the threshing, we do not as yet know what amount of "flax-seed" is to be found in them, and we need report from competent inspection, so that we may know with certainty what amount of "flax-seeds" are to be found in them. It will be eminently desirable that infested chaff should be mixed with wet manure, or destroyed as may be most convenient as rapidly as possible.

One of the most important remedies or means of prevention of damage is hearty growth, which will carry the young plant through moderate attack, or, if part perishes, will carry the other shoots on; and another is the choice of hard-stemmed wheat.

The evidence now coming in points to the possibility of the "flax-seeds" being loosened, and more observations will shortly be sent in; but meanwhile (see p. 16) it is of the utmost importance, in threshing infested crops, that the siftings taken from immediately below the machine should be burnt.

Dressings, &c.

Lime, soot, salt, and "plaster" are mentioned as being serviceable as dustings on young plants infested by maggots. By plaster I am informed burnt gypsum or plaster of Paris is intended. There appear to be various opinions as to real benefit from these applications, and also whether they can, even when melted by rain, reach the maggot sufficiently to destroy it; but, in case of any dressing being useful, it seems likely that the mixture found serviceable many years ago by Mr. Fisher Hobbs might answer still better, as in this the gas-lime would take the place of the gypsum or plaster. The mixture consists of quicklime and gas-lime, each one bushel; soot, ten pounds; sulphur, six pounds; the whole to be well powdered and mixed and applied when the dew is on. The above amount was sufficient for dressing two acres of turnips as a preventive for fly, and the quantity could be increased at discretion. This application would in any case be useful by promoting good growth, which is a point very much dwelt on as a preventive of overwhelming damage from attack; in illustration of this point a note is given in Dr. Packard's paper, previously quoted, regarding attack to a field of young wheat. In the hollows on deep soil "the wheat was very large, and kept green and growing; while on the sharp points of knolls and hard clay ridges it was nearly gone. On a piece of new land near by, where never a kernel of grain was grown before, no fly or injury could be seen." The first part of the above observation agrees very much with what I saw on the attacked land at Revell's Hall. One large field of about thirty acres at the top of the hill, and another adjoining, which were on dry shingly soil and greatly exposed, were much the worst attacked; whilst another in the hollow, which was cooler and better land altogether, had not suffered nearly so much. Should we have the misfortune of this attack settling down amongst us it will be worth observation to find whether the fly comes worst

to the crops sown alone or with clover or seeds. In the fields above mentioned the worst attacked were barley alone; the least attacked had clover and seeds.

Rotation of crop which excludes wheat, barley, or rye on attacked land, is exceedingly important; the Hessian Fly only attacks some of the cereals, therefore all leguminous and root-crops are perfectly safe, and likewise, as they cannot be used as food, help greatly in lessening the prevalence of the pest.

The choice of kinds of corn with hard stems, such as cannot be easily injured by the suction of the maggot, is also particularly dwelt on and kinds named, but as these differ from our English kinds it is unnecessary to give the list. A summary of the above might be shortly stated thus, beginning at harvest-time* :—

If possible reap so as to leave the “flax-seeds” in the stubble, and destroy this infested stubble; otherwise treat the harvested straw so as to destroy them.

If flies are likely to be about let the self-sown corn on fields that were infested sprout, and presently turn sheep on to feed off the infested plants, and then plough the remains in. Ploughing in infested stubble is also useful. “Bait” may also be had recourse to by sowing strips or patches of corn to attract the fly, and treating them as above.

Late sowing, so that the young wheat will not be up until the autumn brood is dead, is a most important precaution, but, as it appears to be safe if put in after the beginning of October, this point is usually met in this country without special arrangements.

Dressings, and mechanical measures, as rolling, &c., may or may not answer, according to circumstances.

* In American treatment the great importance of preserving the insect parasites, which feed on the Hessian Fly in its early stages, is most urgently insisted on, as in that country they are as much looked to for keeping down the attack as Ladybirds are in our own as a check on Hop Aphids. Consequently burning stubbles, or burying them deeply, or other treatment which would kill parasites as well as pests, is thought doubtfully of. In the foregoing notes I have not entered on this consideration, because as yet we do not know that the parasite insects have followed in the train of the fly.

All measures to secure good hearty growth, such as may carry the moderately injured plants through attack, are very desirable.

So is rotation of crop, as the fly only attacks certain cereals specified.

Strong-stemmed corn is less liable to attack than kinds of which the outside is more readily injured by the maggots.

The above methods of treatment mitigate the violence of the attack, and if in the coming season we find this injury, which has now for over a hundred years caused from time to time such devastating loss in America, has settled down here, we cannot do better than study in full detail the reports of observation and agricultural treatment which have been found to mitigate the evil.

But meanwhile it is most urgently to be considered, WHERE DID THE ATTACK COME FROM? As in the hundred years and more that it has been in America, and about half that time that it has been known in Europe, we have no records of its presence as a crop-pest; and plenty of records of it not being present it is reasonable to suppose that there has been some special circumstance which has not occurred before to which we owe its presence. To find what this is would be to find how to free ourselves from a most dangerous crop-pest, and if all concerned would examine into the various ways in which it can have been conveyed on the land, and will continue this watch and report on it in the coming season, we may hope to learn the source of the evil.

I will venture to add that I shall have pleasure in receiving any communication on the subject, or samples of infested grain, and also samples of winter wheat or barley considered to be infested, and in giving all information that lies in my power on the subject.

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